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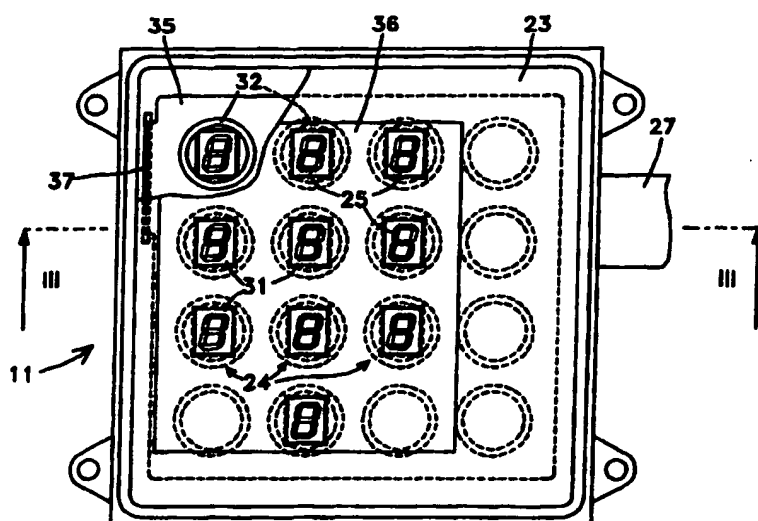
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(54) Title: FRAUD-PROOF KEYBOARD FOR AN AUTOMATIC BANKING TERMINAL



## (57) Abstract

A fraud-proof keyboard (11, 111, 211) for an automatic banking terminal (10) suitable for preventing the keys pressed on the keyboard by the person using the terminal during a banking operation from being detected and used to trace the personal identification code (PIN) or other confidential user data. The keyboard comprises means that automatically and randomly vary, between two successive banking operations, the number and/or symbol (25) associated with each key. More specifically the keyboard, according to a first embodiment (11), comprises a series of keys (24) each provided with a luminous matrix (31) suitable for displaying, in each banking operation, a different number and/or symbol or, according to a second embodiment (111), is built with a touch screen (112) arranged above a display unit (113), wherein the keys to be pressed are defined by areas (114) of the said display unit (113) and the numbers and/or symbols (25) represented thereon also change after each banking operation.

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**FRAUD-PROOF KEYBOARD FOR AN AUTOMATIC BANKING TERMINAL****FIELD OF THE INVENTION**

The present invention concerns a fraud-proof keyboard for an automatic banking terminal, suitable for preventing acts of fraud being perpetrated on the users of the terminal and comprising a plurality of keys, each of which represents a number and/or graphic symbol and may selectively be actuated in order to enter data in the terminal. In particular the keyboard is envisaged to prevent the actuations of its keys by the user being detected by outsiders in order to trace confidential user data, such as for instance the personal identification code (PIN) which, as is known, enables banking operations to be effected.

**BACKGROUND OF THE INVENTION**

A known system for fraudulently detecting the PIN of a user is that of laying a very thin sheet, practically imperceptible to the sight and touch of the user, but suitable for detecting the marks left by his fingers during the entry of data. Once the banking operation has been concluded by the user, the sheet is lifted off the keyboard and the marks impressed thereon used to trace the PIN.

Another possible means of fraud is that of concealing a telecamera in the vicinity of the keyboard in order to film the movements of the user's fingers when entering personal data, and thus tracing the user data by subsequently analysing the movements filmed.

In state-of-the-art keyboards, the keys are indicative of numbers and/or symbols permanently associated therewith, so that the data typed are easy to detect using the systems described above.

### SUMMARY OF THE INVENTION

5       The object of this invention is the provision of a device that is extremely effective against fraud of all types and in particular the types described above, and which in addition is also easy to install, at low cost, including in banking terminals already in operation.

10       This object is achieved by the fraud-proof keyboard according to the present invention which, in accordance with a first embodiment, has the characteristics defined in claim 1. According to another aspect of the invention, the fraud-proof keyboard may have another embodiment, the characteristics of which are defined in claim 7.

15       In particular, the first embodiment is suitable for being installed without distinction in terminals located in attended or unattended environments, being effective in avoiding fraud by way of telecameras and by way of the sheet laid over the keyboard.

20       The further embodiment, on the other hand, is especially suitable for being installed in banking terminals located in attended environments, where it is possible to perform fraud only by way of the sheet laid over the keyboard, it being practically impossible to install telecameras in an attended area.

### BRIEF DESCRIPTION OF THE DRAWINGS

These and other characteristics, scopes and advantages of this invention will become apparent in the course of the following description of some of the preferred embodiments, provided as a non-exhaustive

5 example, taken in conjunction with the accompanying drawings, where:

Fig. 1 is a perspective view of an automatic banking terminal in which a fraud-proof keyboard according to the invention is installed;

Fig. 2 is a plan view of a first embodiment of the keyboard according to the present invention;

10 Fig. 3 is a partial section according to the line III-III of Fig. 2;

Fig. 4 is a functional block diagram of the keyboard of Fig. 2;

Fig. 5 is a diagram illustrating operation of the keyboard of Fig. 2;

Fig. 6 is a partial sectional view of a second embodiment of the keyboard of Fig. 2;

15 Fig. 7 is a functional block diagram of the keyboard of Fig. 6;

Fig. 8 is a plan view of a further embodiment of the keyboard according to this invention;

Fig. 9 is a partial sectional view of the keyboard of Fig. 8; and

Fig. 10 is a diagram illustrating operation of the keyboard of Fig. 8.

### 20 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to Fig. 1, an automatic banking terminal 10, more generally known as an ATM - the abbreviation of Automatic Teller Machine, incorporates a fraud-proof keyboard 11 according to the present

invention. The keyboard 11 is mounted on a fixed structure 12 of the terminal 10 and is associated with a series of operating units of the latter-named, such as for example a display 13, a reader 14 of personal cards, a device 16 for issuing receipts and a cash dispenser unit 15, enabling a user  
5 to perform a banking operation through the said terminal 10.

In particular, before any generic banking operation, the user is enabled to effect the operation by introducing a personal card in the reader 14 and typing his PIN on the keyboard 11. If the data read by the reader 14 on the personal card and the PIN data typed are correct in the sense  
10 that both match with data stored within the terminal 10, then the user is enabled to effect the operation desired.

With reference to Figs. 2-4, the keyboard 11 comprises a support case 21, a front 23 arranged on a side of the keyboard 11 facing the user, a plurality of keys 24 actuated by a user for entering data in the terminal  
15 10, an electronic circuit 26 arranged under the keys 24, and an output line 27. On each actuation by the user, each key 24 generates a corresponding actuation signal S1, designed to be received by the electronic circuit 26. The latter in turn processes the actuation signals S1 of the keys 24 before generating corresponding output signals S2 indicative of the data entered  
20 by the user. A line 27 is provided for transmitting the signals S2 to the outside of the keyboard 11 towards computing units of the terminal 10.

Both the case 21 and the front 23 possess a particularly robust structure to protect the exterior and interior of the keyboard 11 against

acts of vandalism and against all forms of tampering, designed for instance to detect the signals circulating within the keyboard 11 in order to fraudulently pick up the data entered by the user.

The electronic circuit 26 is divided into a main circuit 28, which  
5 directly receives the actuation signals S1 generated by the keys 24, and a security circuit 29 associated with the main circuit 28 and suitable for rendering secure the transfer of data from the keyboard 11 to the computing units of the banking terminal 10. For this purpose, the security circuit 29 is suitable for arranging the output signals S2 in a special secret  
10 form, also called encrypted, designed to prevent the signals from being deciphered and the data being obtained fraudulently.

The keys 24 are associated with a plurality of numbers and/or graphic symbols 25, each of which is represented on a corresponding key 24 to indicate the data that it is possible to input and enter in the terminal  
15 10, by actuating the key in question.

According to one characteristic of the invention, the keyboard 11 is provided with means suitable for randomly varying, between two successive banking operations, the numbers and/or symbols 25 represented on the keys 24, so that the marks left by the fingers of a user  
20 on a sheet laid above the keyboard 11 for fraudulent designs, do not permit unfailing determination of the numbers and/or symbols that were typed by the user.

More specifically each key 24 comprises a luminous matrix 31 of known characteristics, also known as a "digit", which consists of a plurality of elements that are selectively lit to represent the numbers and/or graphic symbols 25. The matrices 31 are mounted on a support board 33  
5 connected with the main circuit 28 and bearing appropriate circuits for electrical power supply of the matrices 31.

The matrices 31 are apt to be driven by the main circuit 28 for varying, between two successive banking operations, brightness of the respective illuminating elements, so that the numbers and/or graphic  
10 symbols 25 represented on the matrices 31 change according to a random law, but in such a way that, on each variation, all the numbers and/or symbols 25 needed for data entry still appear in their entirety on the various keys 24. It will therefore be clear that the keyboard 11 is suitable for presenting, during a generic banking operation, a different and  
15 unpredictable arrangement of the numbers and/or symbols 25 on the keys 24 with respect to the arrangement presented during the preceding banking operation.

In ways that are widely known and used in the sector art, the random variation of the numbers and/or symbols 25 represented on the  
20 keys 24 may be obtained by means of a specific circuit, integrated in the electronic circuit 26 and of a type capable of generating random numbers.

Each key 24 further comprises a piezoelectric element 32 arranged above the luminous matrix 31 and suitable for generating, through the



effect of pressure applied by the user, the signal S1 indicating actuation of the key in question. The different piezoelectric elements 32 are supported by a sheet 35, and each possesses a crown shape around a hole in the sheet 35 with the purpose of permitting observation by the user of the  
5 number or symbol displayed by the matrix 31.

A flexible plate 36, arranged on top of the sheet 35 on the external face of the keyboard 11, is provided with transparent areas in correspondence with the luminous matrices 31 to permit observation of the relative numbers and/or symbols 25 and is sufficiently thin so as to bend  
10 and transmit the pressure of the user to the different piezoelectric elements 32 underneath in order to activate them.

A cable 37 connects the sheet 35 with the electronic circuit 26 for transmission to the latter of the actuation signals S1.

The electronic circuit 26 is also provided with circuits associating the  
15 actuation signals S1 generated by the piezoelectric elements 32 with the numbers and/or graphic symbols 25 represented on the keys 24 at the time they are actuated, in order to enter in the terminal 10 the data effectively input by the user.

Operation of the keyboard 11 described thus far is as follows. At the  
20 start of each new banking operation, the user inserts his personal card in the reader 14. When the terminal 10 verifies presence of the card, the electronic circuit 26 drives (phase 41 in Fig. 5) the luminous matrices 31 so as to vary according to a random law the numbers and/or symbols 25

represented thereon, so that the latter adopt a completely unpredictable disposition from the one they had during the previous banking operation. At this point, the user types his data (phase 42) by pressing the various keys 24, and the piezoelectric elements 32 relative to each of the keys  
5 pressed generate corresponding actuation signals S1 which are received by the electronic circuit 26. The latter associates (phase 43) the actuation signals received with the effective disposition of the numbers and/or symbols 25 on the keys 24 at that time, in order to ascertain the data effectively input by the user. These data are then transferred to outside the  
10 keyboard in encrypted form by means of the output signals S2 transiting on the line 27.

A second embodiment of the fraud-proof keyboard, indicated with the numeral 111 and illustrated in Figs. 6 and 7, comprises a support case 115, a substantially transparent, tactile type screen 112, a display unit 113  
15 arranged under the screen 112, and a main electronic circuit 126.

The screen 112, of known characteristics and of the type commonly called touch screen, is provided with tactile properties so that, when touched at any point of the surface, it generates a corresponding contact signal S3. Further, the screen 112 is provided with a grid suitable for  
20 conveying the contact signal S3 thus generated to a suitable recognition circuit, integrated in the circuit 126, suitable for recognizing exactly which zone of the surface of the screen 112 has been touched.

The display unit 113 is, for example, of the liquid crystal type (LCD) and is suitable for displaying the numbers and/or graphic symbols 25, indicative of the data input using the keyboard 111, inside areas 114 arranged in a pre-established way on the surface of the said display unit

5 113.

These areas 114 with the relative numbers and/or symbols are clearly visible to the user, as the screen 112 is transparent:

The electronic circuit 126 is suitable for driving the display unit 113 so that the numbers and/or symbols 25 displayed in the areas 114 vary

10 randomly between two successive banking operations, in the same way as already seen for the keyboard 11.

In using the keyboard 111, the users inputs his data by touching the screen 112 exactly on the areas 114 with the numbers and/or symbols indicating the data, and accordingly activates a series of contact signals

15 S3. The latter are received by the circuit 126 where they are associated with the above-mentioned areas 114 and with the numbers and/or symbols 25 represented thereon at that time, so that the data effectively input by the user may be ascertained and entered in the terminal 10.

Figs. 8 and 9 represent a further embodiment of the fraud-proof

20 keyboard, indicated generically by numeral 211. It consists of a conventional type keyboard body 212, provided with keys 224, and a device 213 suitable for detecting the presence of foreign elements on the outer surface of the keys 224.

In further detail, the device 213, also called wave conveyor, comprises a transmitter 214 emitting sound waves 215 of predefined characteristics and a receiver 216 suitable for receiving these waves and measuring the characteristics thereof. The transmitter 214 and the receiver  
5 216 are arranged one in front of the other on opposite sides of the keyboard 211 so that the waves emitted by the transmitter 214 are conveyed along the surface of the keys 224 to the receiver 216.

Operation of the keyboard 213 is as follows.

At the beginning of each banking operation, the device 213 during  
10 phase 231 (Fig. 10) verifies if the characteristics of the waves 215 received by the receiver 216 are conforming to the predefined characteristics of the waves emitted by the transmitter 214. If they are conforming, the keyboard 211 prepares to receive the user data so that the banking operation may be duly effected. During the time required for the  
15 operation, the device 213 is disabled in order to avoid the device 213 unduly signalling a change in status of the surface of the keys 224 on account of the keys pressed by the user.

If they are not conforming, the keyboard 211 informs the user (phase 232), for example by posting a suitable message on the display 13,  
20 that surface conditions of the keys 224 have been altered from their normal conditions and that action must be taken to remove the reason for this alteration. At the same time, the keyboard 211 is disabled, so that the

user can no longer continue effecting the banking operation. This bar remains until such time as the cause of the alteration is removed.

It is obvious that various changes and/or improvements may be made to the fraud-proof keyboard corresponding to the preferred  
5 embodiments described in the foregoing, without exiting from the scope of the present invention.

## CLAIMS

1 - A fraud-proof keyboard (11; 111) for an automatic banking terminal (10), comprising

a plurality of keys (24), each of which represents a number and/or  
5 graphic symbol (25) and is provided for being selectively actuated in order to enter data in the terminal (10),

characterised by electronic variation means (26, 31; 126, 113) for varying the number and/or symbol (25) represented on each of said keys (24).

10 2 - A keyboard (11; 111) according to the claim 1, wherein each of said keys (24) is suitable for generating a corresponding electric actuation signal (S1; S3), and wherein an electronic circuit (26; 126) is provided for receiving said electric actuation signal (S1; S3), characterized in that said electronic circuit (26; 126) is suitable, when a generic key (24) is actuated,  
15 for associating the corresponding actuation signal (S1; S3) with the number and/or graphic symbol (25) represented on said generic key (24), whereby the datum corresponding to the number and/or graphic symbol represented on said generic key (24) is entered in said terminal (10).

3 - A keyboard (11; 111) according to either claim 1 or 2, characterized in  
20 that said electronic variation means comprise a luminous matrix (31) for each of said keys (24) and in that each luminous matrix (31) is suitable for lighting variably between two successive banking operations, in order to

display a different number and/or graphic symbol (25) on the corresponding key (24).

4 - A keyboard according to the claim 3, characterized by the fact that each of said keys (24) comprises a piezoelectric element (32) for  
5 generating said actuation signal (S1), by the fact that the piezoelectric elements (32) of the various keys (24) are arranged on a sheet (35) laid on top of said luminous matrices (31), and by the fact that each of said piezoelectric elements (32) is associated with a transparent area of said sheet (35) to permit observation of the number and/or symbol represented  
10 on the respective key.

5 - A keyboard according to the claim 2, characterized by the fact that said electronic variation means comprise a display unit (113) having a plurality of areas (114) each of which defining a corresponding key, by the fact that a touch screen (112) is laid on top of said display unit (113) for generating  
15 the electric actuation signals (S3) of said keys, and by the fact that each of said areas (114) is suitable for representing a different number and/or graphic symbol (25) between two successive banking operations.

6 - A keyboard (11; 111) according to either claim 1 or 2, characterized by the fact that said electronic variation means comprise random number  
20 generating means, so that the numbers and/or symbols represented on said keys vary randomly between two successive banking operations.

7 - A fraud-proof keyboard (211) for an automatic banking terminal (10), comprising a plurality of keys (224), each of which represents a number

and/or graphic symbol (25) and may selectively be actuated in order to enter data in the terminal,

characterized by having a wave conveyor type device (213) for signalling an alteration of the surface state of said keys (224) between two  
5 successive banking operations.



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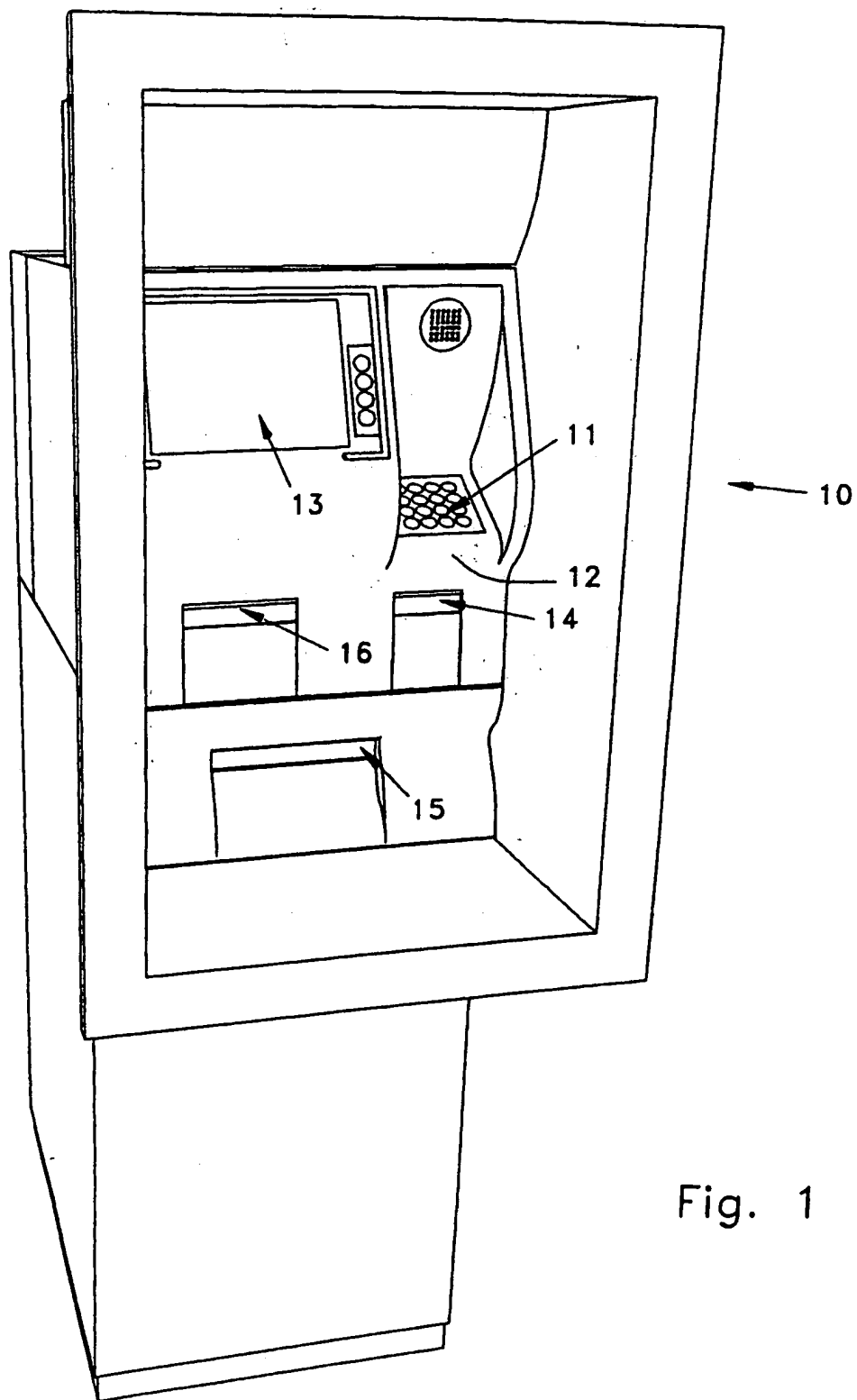


Fig. 1

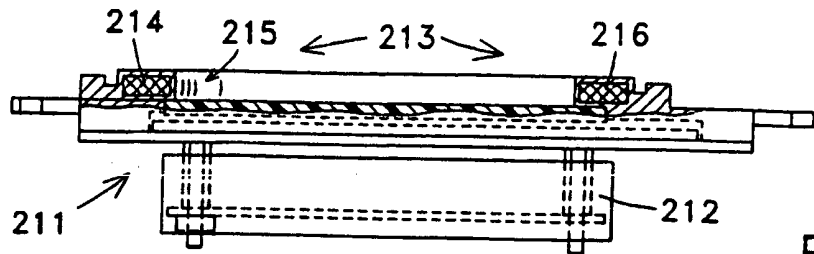


Fig. 9

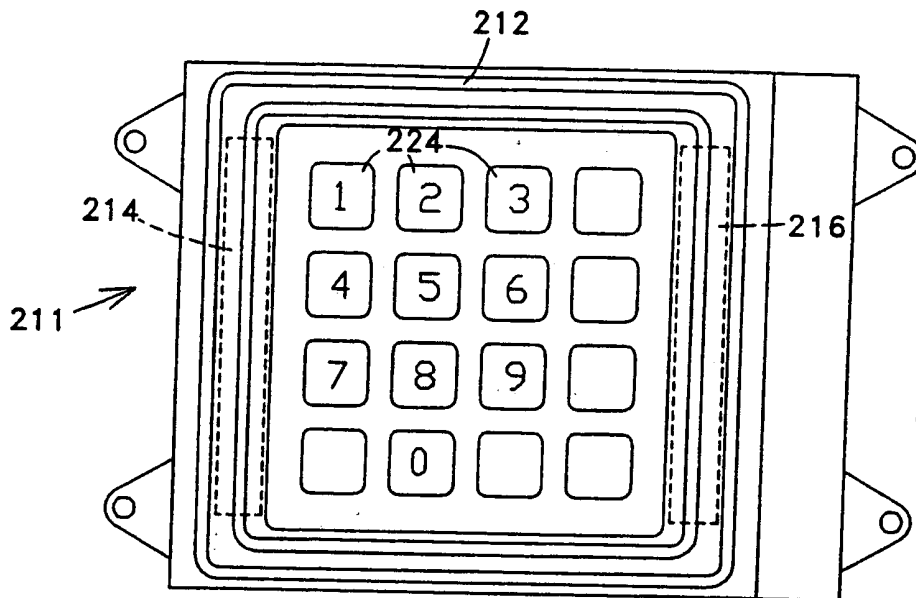


Fig. 8

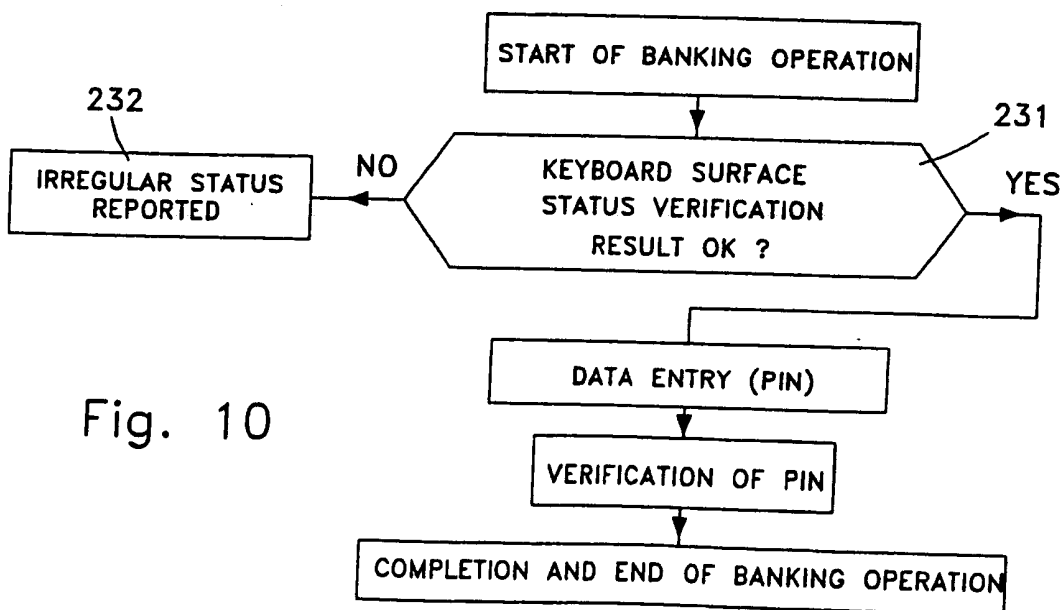


Fig. 10

# INTERNATIONAL SEARCH REPORT

International Application No.

PCT/IT 97/00308

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 G07F7/10

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G07F G07C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 147 837 A (OMRON TATEISI ELECTRONICS) 10 July 1985	1-3,5,6
A	see abstract; claims; figures 1-3 see page 7, line 1 - page 10, line 11	4
A	DE 41 29 202 A (HAUNI ELEKTRONIK) 4 March 1993	
A	US 4 333 090 A (S.B. HIRSCH) 1 June 1982	
A	FR 2 622 322 A (A. DE WECK) 28 April 1989	

☐ Further documents are listed in the continuation of box C.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0147837 A	10-07-85	JP 60134377 A	17-07-85
DE 4129202 A	04-03-93	NONE	
US 4333090 A	01-06-82	US 4479112 A	23-10-84
FR 2622322 A	28-04-89	NONE	